C307

Impact of Climate Change on Tropical Peat Fire Risk

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1. Introduction

Located in the humid tropical region, fires in the tropical peatlands of Indonesia rarely happened in natural state (Miettinen et al., 2017). The long-term climate variability (e.g. glacial and non-glacial climate) and short-term climate oscillations known nowadays as El-Niño Southern Oscillation (ENSO) has increased the susceptibility of peatlands to fire, thus causing some fire activities even in its nature state (Goldammer, 2007). Under the current state, the severely modified tropical peatlands have much higher susceptibility to fire causing more frequent and larger fire events in response to the climate variabilities.

Recent publications suggested that the future warmer climate will lead to more frequent, longer and larger wildfires globally. Yet, the impact to tropical peatlands' fires are still unclear, particularly, the ones located in the maritime continent where major fires are strongly influenced by ENSO.

How ENSO responses to a warmer climate was inconclusive for decades. Until recently, Cai et al. (2020) mentioned that there is an increase in the frequency of extreme El-Nino from once in 16.2 years to once in 6.93 years. Even though there are still questions on how future ENSO influence the regional climates, it is important to understand how the future climate influence the frequency, magnitude and duration of peatlands' fires particularly the ones in the maritime continent.

This abstract shows the preliminary results of fire occurrences in the tropical peatlands of Indonesia in the future.

2. Methodology

Fire Index

Here, the Keetch-Byram Drought Index (KBDI) was used to estimate the future fire risks. We used Area Under the Curve (AUC) of Relative Operating Curve (ROC) to understand the performance of the index in the peatlands. The AUC of KBDI is 0.923 showing that the index has good predictability of fires.

Developed for Florida State, USA, KBDI is a proxy of cumulative soil moisture deficit by estimating the net effects of precipitation and evapotranspiration.

$$KBDI^t = KBDI^{t-1} + DF^t - RF^t$$

where DF is drought factor and RF is rainfall factor. The index is calculated by updating the previous day $KBDI$ value (superscript $t-1$) using daily drought and rainfall factors (superscript t).

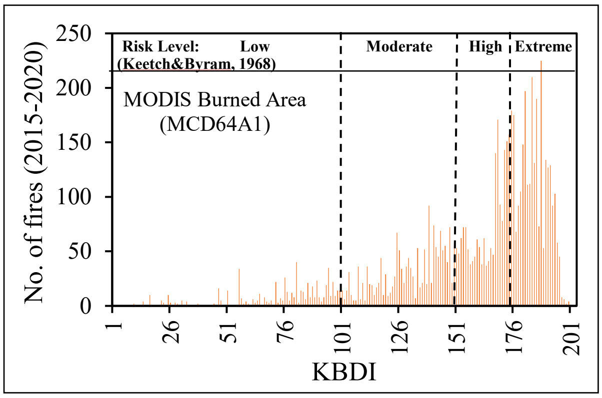

Figure 1. KBDI value vs. fire occurences

Data

In order to estimate future fire risks, daily rainfall and maximum temperature of statistically downscaled MRI-CGCM3 (NEX-GDDP-CMIP 5) were used to calculate KBDI values in the future. The high fire risks area was defined as areas with KBDI > 175.

3. Results and Discussions

Our results show that the area with high fire risk (KBDI>175) will increase in the future. The historical average area with fire risk is about 42,000 km^2 will increase to 75,000 km^2 (RCP4.5) and 137,000 km^2. (RCP8.5) in the far future (2080-2099) (Figure 2).

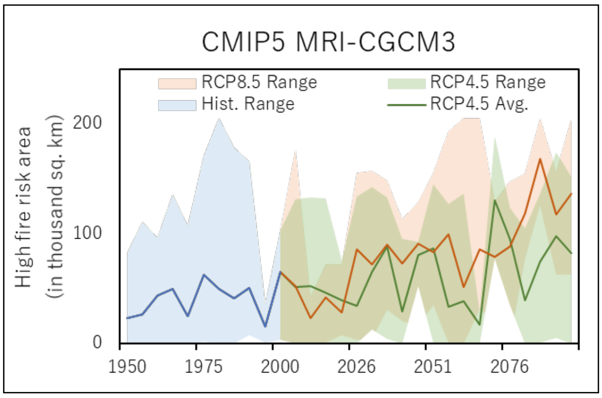

Figure 2. High fire risk area in historical and future climates

Major fire events (where high fire risk areas are more than half of peatlands) is increasing in the future. The major events per ten years is about 1 event in historical period. This value will increase up to 4 events (RCP 4.5) and 8 events (RCP 8.5) in the far future (Figure 3).

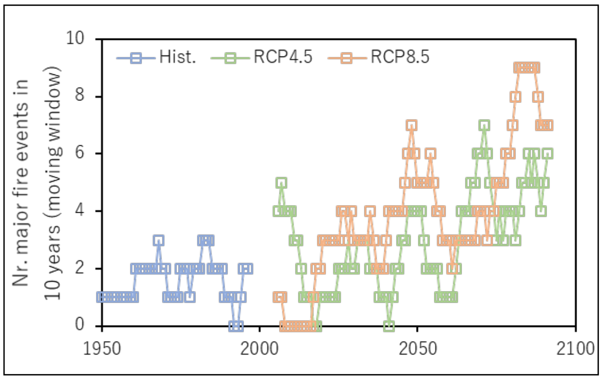

Figure 3. Major fire events in historical and future climates

In the near future (2040-2059), the results show that the major fire events will already increased to 2 events in (RCP4.5) and 4 events (RCP8.5) in 10 years.

The results also show the maximum duration of peatland areas that is under high fire risk condition. The area can be only a small portion of the peatlands. In historical period, the average is about 1 month. In the far future, the duration can increase to 3 months (RCP4.5) and 3.5 months (RCP8.5).

The distribution of fire risk in based on fire on ENSO year in 2015 show that the southern part of Sumatra and Kalimantan peatlands have higher fire risk compare to the northern part. The portion of high fire risk area will increase in the future regardless the RCP scenarios.

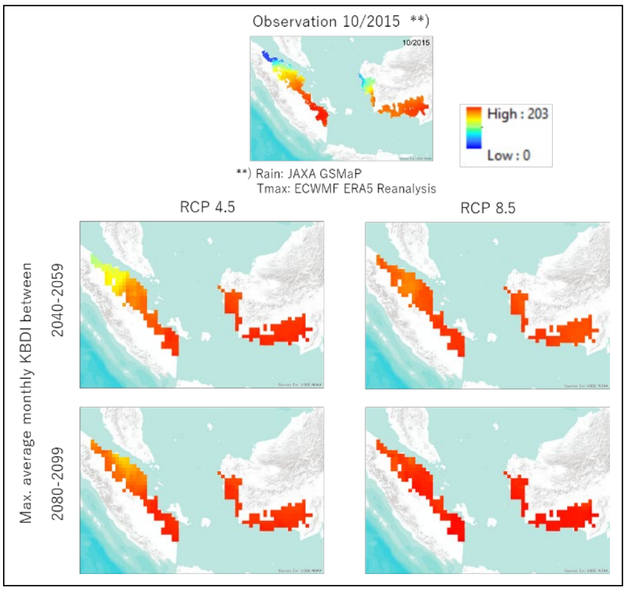

Figure 4. Distribution of high fire risk area over the years

The distribution of fire risk in based on fire on ENSO year in 2015 show that the southern part of Sumatra and Kalimantan peatlands have higher fire risk compare to the northern part. The portion of high fire risk area will increase in the future regardless the RCP scenarios.

Although the results seem to be inline with the general view on future wildfires as well as with the increase of extreme ENSO frequency, there are still a lot of uncertainty in these results. Particularly that the fires in the region is mostly ignited through anthropogenic activities.

4. Conclusions

We analyzed the impact of warmer climate to fire risk in the tropical peatlands in maritime continent. The results show that the fire risk will increase particularly in the far future in terms of area, frequency and duration. We also estimated that the distribution of high fire risk area will be different compare the present condition.

References

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